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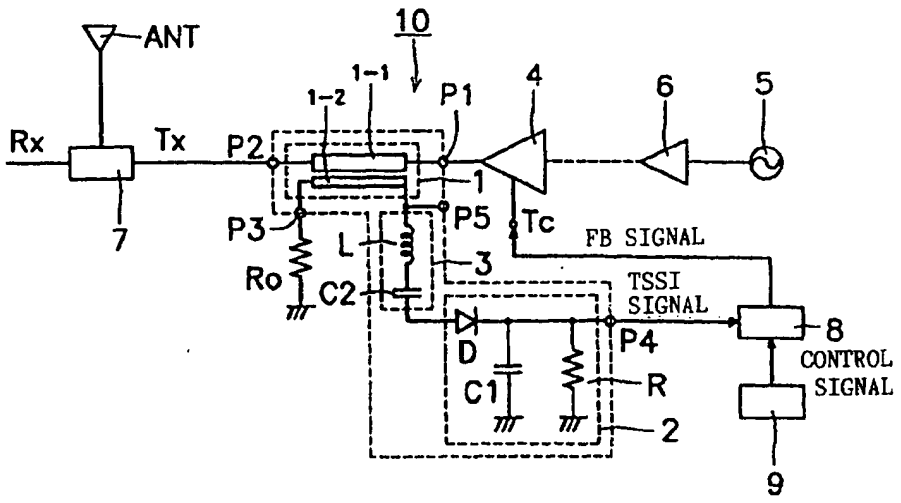
(54) Transmission output control device, and radio equipment including the same

(57) There is disclosed a transmission output control device (10) comprising: a directional coupler (1) to branch a part of a transmission signal amplified by a high output amplifier (4); and a detector (2) to detect a part of said branched transmission signal; wherein said directional coupler (1) and said detector (2) are integrated with a laminated body in which a plurality of dielectric layers are laminated.

FIG. 1



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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a transmission output control device and a radio equipment including the same, and more specifically, a transmission output control device to control the transmission signal to be emitted from an antenna, and a radio equipment including the same.

2. Description of the Related Art

[0002] Generally, in a radio equipment including a cellular phone terminal, the transmission output level of the transmission signal at the terminal is switched in multiple stages or continuously following the instruction of a base station to save the power consumption or to reduce the interference with other terminals.

[0003] Fig. 10 is a block diagram illustrating a basic constitution of a transmission part of the cellular phone terminal to control the above-described transmission output. A transmission output control device 50 is provided with a directional coupler 51 and a detector 52.

[0004] A carrier-wave signal generated in an oscillator 53 is converted into the transmission signal through various processing circuits including an amplifier 54, and inputted in a high output amplifier 55. The transmission signal amplified by this high output amplifier 55 is inputted in an antenna multicoupler 56 through the directional coupler 51, and transmitted from an antenna 57 after unwanted waves are removed by the antenna multicoupler 56. Further, a reception signal received by the antenna 57 is inputted in a reception part Rx after unwanted waves are removed by the antenna multicoupler 56. The instruction information on the transmission output level of the transmission signal is included in the above-described reception signal from the base station.

[0005] The directional coupler 51 comprises a main line 51-1 and a sub line 51-2, and a part of the transmission signal from the high output amplifier 55 is branched, that is; taken out from one end of the sub line 51-2 and inputted in the detector 52. A terminating resistor R51 is connected to the other end of the sub line 51-2. In the detector 52, the transmission signal is rectified by a detection diode D51, and then, changed into the detection signal through the DC-smoothing by a smoothing capacitor C51 and a load resistor R52. The detection signal is inputted in a control circuit 58 as the TSSI (Transmitting Signal Strength Indicator) signal corresponding to the transmission output level of the transmission signal to be actually transmitted from the antenna 57.

[0006] A control part 59 gives the control signal to indicate the specified transmission output level to the control circuit 58 following the instruction from a base station not indicated in the figure. The control circuit 58 forms the feedback (FB) signal to be effected so that the difference between the actual transmission output level to be recognized from the TSSI signal and the target transmission output level is reduced by the control signal from the control part 59, and outputted to a control terminal Tc capable of varying the actual transmission output level by the high output amplifier 55.

[0007] As described above, a transmission output control system a part of which comprises the transmission output control device 50 forms a feedback loop, and controls the transmission output level so that the actual transmission output level becomes the target transmission output level given by the control part 59.

[0008] Recently in North America, a dual-band type cellular phone terminal ready for the AMPS (Advanced Mobile Phone Services : 800 MHz band) and the PCS (Personal Communication Services : 1900 MHz band) by one cellular phone terminal has been developed.

[0009] Fig. 11 is a block diagram illustrating a basic constitution of a transmission part of the above-described dual-band type cellular phone terminal. A transmission output control device 60 is provided with first and second directional couplers 61a, 61b and a detector 62. The transmission output control device 60 constitutes the transmission output control system forming the feedback loop together with first and second high output amplifiers 63a, 63b, a control circuit 64 and a control part 65. The operation of the transmission output control system including the transmission output control device 60 is same as that of the transmission output control system including the transmission output control device 50 of Fig. 10.

[0010] However, the conventional transmission output control device described above, is formed by respectively mounting discrete parts to constitute a directional coupler, a detector and a tuner on a circuit substrate, and the transmission output control device is increased in size, and as a result, there has been a problem that the radio equipment is increased in size.

[0011] Further, because the discrete parts to constitute the directional coupler, the detector and the tuner of the transmission output control device are connected to each other by the wiring provided on the circuit substrate, the loss due to the wiring is increased, and there has been a problem that the characteristic of the transmission output control device is degraded.

[0012] In addition, in a case of the dual-band type, a gap between directional couplers must be ensured to obtain the isolation between a plurality of directional couplers, and thus, the transmission output control device is further increased in size, and as a result, there has been another problem that the radio equipment is further increased in size.

SUMMARY OF THE INVENTION

[0013] To overcome the above described problems, preferred embodiments of the present invention provide

a compact transmission output control device with excellent characteristic and a radio equipment including the same.

[0014] One preferred embodiment of the present invention provides a transmission output control device comprising: a directional coupler to branch a part of a transmission signal amplified by a high output amplifier; and a detector to detect a part of said branched transmission signal; wherein said directional coupler and said detector are integrated with a laminated body in which a plurality of dielectric layers are laminated.

[0015] According to the above described structure and arrangement, each wiring of the directional coupler and the detector can be provided inside the laminated body because the directional coupler and the detector to constitute the transmission output control device are integrated with the laminated body in which a plurality of dielectric layers are laminated. Thus, because the loss in each wiring can be reduced, the transmission output control device with excellent characteristic can be obtained.

[0016] In the above described transmission output control device, said directional coupler may include a main line and a sub line; said detector may include a detection diode, a smoothing capacitor and a load resistor; the detection diode and the load resistor of said detector may be mounted on said laminated body; the main line and the sub line of said directional coupler may comprise strip line electrodes provided inside said laminated body; and the smoothing capacitor of said detector may comprise a capacitor electrode and a ground electrode provided to be opposed each other via said dielectric layers inside said laminated body.

[0017] According to the above described structure and arrangement, the number of parts of the transmission output control device can be reduced because the main line and the sub line of the directional coupler comprise strip line electrodes provided inside the laminated body, and the smoothing capacitor of the detector comprises the capacitor electrode and the ground electrode provided opposite to each other via the dielectric layer inside the laminated body. Thus, a compact transmission output control device can be obtained, and the occupied area by the transmission output control device can be reduced in a radio equipment on which this transmission output control device is mounted.

[0018] In the above described transmission output control device, a plurality of said directional couplers may be provided; and the plurality of said directional couplers may be ready for the transmission signal of different frequencies and disposed on different dielectric layers out of a plurality of said dielectric layers.

[0019] According to the above described structure and arrangement, a plurality of directional couplers can be arranged through the dielectric layers because a plurality of directional couplers ready for the transmission signal of different frequency are formed on different dielectric layers inside the laminated body. Thus, sufficient isolation between a plurality of directional couplers can be ensured. As a result, a transmission output control device with excellent characteristic can be obtained.

[0020] Another preferred embodiment of the present invention provides a radio equipment including the above described transmission output control device.

[0021] According to the above described structure and arrangement, a compact radio equipment can be realized while keeping the excellent transmission characteristic because a compact transmission output control device with excellent characteristic is used.

[0022] Other features and advantages of the present invention will become apparent from the following description of the invention which refers to the accompanying drawings.

BRIEF DESCRIPTION OF DRAWINGS

[0023] FIG. 1 is a block diagram illustrating a basic constitution of a transmission part of a radio equipment using a first embodiment of a transmission output control device of the present invention.

[0024] FIG. 2 is a partly exploded perspective view of the transmission output control device of Fig. 1.

[0025] FIGS. 3A, 3B, 3C, 3D, 3E, 3F and 3G are top plan views of a first dielectric layer to a seventh dielectric layer which constitute a laminated body of the transmission output control device of Fig. 2, and FIG. 3H is a bottom plan view of the seventh dielectric layer.

[0026] FIG. 4 is a circuit diagram of a modified transmission output control device of Fig. 1.

[0027] FIG. 5 is a block diagram illustrating a basic constitution of a transmission part of a radio equipment using a second embodiment of the transmission output control device of the present invention.

[0028] FIG. 6 is a partly exploded perspective view of the transmission output control device of Fig. 5.

[0029] FIGS. 7A, 7B, 7C, 7D, 7E and 7F are top plan views of a first dielectric layer to a sixth dielectric layer which constitute a laminated body of the transmission output control device of Fig. 6.

FIGS. 8A, 8B, 8C and 8D are top plan views of a seventh dielectric layer to a tenth dielectric layer which constitute a laminated body of the transmission output control device of Fig. 6, and FIG. 8E is a a bottom plan view of the tenth dielectric layer.

[0030] FIG. 9 is a circuit diagram of a modified transmission output control device of Fig. 5.

[0031] FIG. 10 is a block diagram illustrating a basic constitution of a transmission part of a general cellular phone terminal.

[0032] FIG. 11 is a block diagram illustrating a basic constitution of a transmission part of a general dual-band type cellular phone terminal.

DESCRIPTION OF PREFERRED EMBODIMENTS

[0033] Fig. 1 is a block diagram illustrating a basic

constitution of a transmission part of a radio equipment using a first embodiment of a transmission output control device of the present invention. In a transmission part Tx, a transmission output control device 10 is provided with a directional coupler 1 comprising a main line 1-1 and a sub line 1-2, a detector 2 comprising a detection diode D, a smoothing capacitor C1 and a load resistor R, a tuner 3 comprising an inductor L and a capacitor C2, and first to fourth terminals P1-P4.

[0034] The directional coupler 1 plays a role to detect a part of the transmission signal amplified by a high output amplifier 4, and the detector 2 plays a role to detect a part of the transmission signal branched by the directional coupler 1. The tuner 3 is arranged between the directional coupler 1 and the detector 2 and plays a role to perform the impedance matching between the directional coupler 1 and the detector 2.

[0035] The first and second terminals P1, P2 are provided on both ends of the. main line 1-1 of the directional coupler 1. The third terminal P3 is provided on one end of the sub line 1-2 of the directional coupler 1, and a terminating resistor Ro is connected thereto. In addition, the fourth terminal P4 is provided on an output end of the detector 2. A fifth terminal is provided between the directional coupler 1 and the tuner 3, and used in evaluating the characteristic of only the directional coupler 1.

[0036] A carrier-wave signal generated in an oscillator 5 is converted into the transmission signal through various processing circuits including an amplifier 6, and inputted in the high output amplifier 4. The transmission signal amplified by the high output amplifier 4 is inputted in an antenna multicoupler 7 through the first terminal P1, the directional coupler 1 and the second terminal P2, and transmitted from an antenna ANT after unwanted waves are removed by the antenna multicoupler 7.

[0037] Further, the received signal by the antenna ANT is inputted in a reception part Rx after unwanted waves are removed by the antenna multicoupler 7. The instruction information on the transmission output level of the transmission signal is included in the above-described reception signal from a base station.

[0038] A part of the transmission signal from the high output amplifier 4 is branched by the directional coupler 1, that is, taken out of an end of the sub line 1-2, and inputted in the detector 2 through the tuner 3.

[0039] In the detector 2, after the transmission signal is rectified by the detection diode D, the transmission signal is changed into the detection signal through the DC smoothing by the smoothing capacitor C1 and the load resistor R. This detection signal is outputted from the fourth terminal P4 as the TSSI signal corresponding to the transmission output level of the transmission signal to be actually transmitted from antenna ANT and inputted in a control circuit 8.

[0040] A control part 9 gives the control signal to indicate the specified transmission output level to the control circuit 8. Based on the control signal from the control part 9, the control circuit 8 forms the feedback (FB) signal to be effected so that the difference between the actual transmission output level to be recognized by the TSSI signal and the target transmission output level is reduced, and outputted to a control terminal Tc capable of varying the actual transmission output level by the high output amplifier 4.

[0041] As described above, a transmission output control system a part of which comprises a transmission output control device 10 forms a feedback loop in the transmission part Tx, and controls the transmission output level so that actual transmission output level is the target transmission output level given from the control part 9.

[0042] Fig. 2 is a partly exploded perspective view of the transmission output control device of Fig. 1. The transmission output control device 10 is provided with a laminated body 11 in which a plurality of dielectric layers (not indicated in the figure) are laminated.

[0043] The detection diode D and the load resistor R of the detector 2, and the inductor L and the capacitor C2 of the tuner 3 are respectively mounted on an upper surface of the laminated body 11.

[0044] External terminals T1 to T8 are provided from a side surface to a lower surface of the laminated body 11. Out of these external terminals, the external terminals T7, T1, T3, T2, T5 form the first to fifth terminals P1 to P5 (Fig. 1) of the transmission output control device 10 and the external terminals T4, T6, T8 form ground terminals.

[0045] Fig. 3A to Fig. 3H are a top plan view and a bottom plan view of each dielectric layer to constitute the laminated body of the transmission output control device of Fig. 2. The laminated body 11 is formed, for example, by successively laminating and baking the first to seventh dielectric layers 11a to 11g formed of a low-temperature baked ceramic mainly consisting of barium oxide, aluminum oxide and silica which can be baked at the temperature of 850°C to 1000°C.

[0046] A land La1 to respectively mount the detection diode D of the detector 2, the load resistor R, and the inductor L and the capacitor C2 of the tuner 3 as illustrated in Fig. 1 is formed on an upper surface of the first dielectric layer 11a. A wiring pattern Lp1 and a ground electrode Gp11 are formed on an upper surface of the second dielectric layer 11b.

[0047] In addition, a capacitor electrode Cp1 is formed on an upper surface of the third dielectric layer 11c. Ground electrodes Gp12, Gp13 are respectively formed on an upper surface of the fourth and seventh dielectric layers 11d, 11g.

[0048] In addition, strip line electrodes ST11, ST12 are respectively provided on an upper surface of the fifth and sixth dielectric layers 11e, 11f. The external terminals T1 to T8 are formed on a lower surface (denoted as 11gu in Fig. 3H) of the seventh dielectric layer. In addition, a via hole electrode Vh1 is formed in the first to sixth dielectric layers 11a to 11f so as to pierce the respective dielectric layers 11a to 11f.

[0049] The main line 1-1 of the directional coupler 1, and the sub line 1-2 of the directional coupler 1 respectively comprise the strip line electrode ST11 and the strip line electrode ST12.

[0050] Further, the smoothing capacitor C1 of the detector 2 comprises the capacitor Cp1 and the ground electrodes Gp11, Gp12 opposite to each other across the second and third dielectric layers 11b, 11c.

[0051] In addition, the elements to constitute the directional coupler 1, the detector 2 and the tuner 3 are connected to each other by the wiring pattern Lp1 and the via hole electrode Vh1 inside the laminated body 11.

[0052] Fig. 4 is a circuit diagram illustrating a modified example of the output control of Fig. 1. A transmission output control device 10a is different from the transmission output control device 10 of Fig. 1 in that the detector 2 is provided with a thermistor 12 which is a temperature-sensing element to compensate the temperature fluctuation, and an input part bias circuit 13 and an output limiter circuit 14 are provided between the tuner 3 and the detector 2.

[0053] The input part bias circuit 13 comprises resistors R1, R2, and a connection point of one end of the resistor R1 to one end of the resistor R2 is connected to an anode of the diode D of the detector 2, and the other end of the resistor R2 is connected to the ground.

[0054] The output limiter circuit 14 comprises a diode D1 and resistors R3, R4, and the diode D1 is connected between a connection point of one end of the resistor R3 to one end of the resistor R4 and a cathode of the detection diode D of the detector 2 so that the connection point side of one end of the resistor R3 to one end of the resistor R4 forms the cathode.

[0055] The other end of the resistor R3 is connected to the other end of the resistor R1 of the input part bias circuit 13, and also connected to a control terminal PB to apply the bias of the diode D1. In addition, the other end of the resistor R4 is connected to the ground.

[0056] Further, the thermistor 12, the resistors R1, R2 of the input part bias circuit 13, the diode D1 of the output limiter circuit 14, and the resistors R3, R4 are mounted on the upper surface of the laminated body 11. A detection terminal PT to take out the signal from the thermistor 12 and the control terminal PB to control the diode D of the output limiter circuit 14 are provided from the side surface to the lower surface of the laminated body 11 as the external terminals, respectively.

[0057] The transmission output control device of the first embodiment as described above, the directional coupler, the detector and the tuner to constitute the transmission output control device are integrated with the laminated body in which a plurality of dielectric layers are laminated, and each wiring of the directional coupler, the detector and the tuner can be provided inside the laminated body, and as a result, the loss in each wiring can be reduced. Thus, the transmission output control device with excellent characteristic can be obtained.

[0058] Because the main line and the sub line of the directional coupler comprise the strip line electrode provided inside the laminated body, and the smoothing capacitor of the detector comprises the capacitor electrode and the ground electrode provided opposite to each other across the dielectric layer inside the laminated body, the number of parts of the transmission output control device can be reduced. Thus, a compact transmission output control device can be obtained, and the occupied area by the transmission output control device can be reduced. As a result, a compact radio equipment can be realized while keeping the excellent transmission characteristic.

[0059] Further, in a modified example of Fig. 4, the temperature characteristic of the detector can be controlled because the detector is provided with the thermistor which is the temperature-sensing element to compensate the temperature fluctuation, and the transmission output can be excellently controlled even when the transmission output control system extensive in the temperature compensation range is constituted.

[0060] The minimum value of the TSSI signal from the transmission output control device to the control circuit is determined by the input part bias circuit, and the maximum value of the TSSI signal from the transmission output control device to the control circuit is determined by the output limiter circuit. Thus, the range of the TSSI signal can be controlled, and as a result, the transmission characteristic of the radio equipment with this transmission output control device mounted thereon can be improved.

[0061] Fig. 5 is a block diagram illustrating the basic constitution of a transmission part of the radio equipment using the second embodiment of the transmission output control device of the present invention. In the transmission part Tx, a transmission output control device 20 is provided with a first directional coupler 1a comprising a main line 1a-1 ready for the transmission signal of different frequency and a common sub line 1-2, a second directional coupler 1b comprising a main line 1b-1 and the common sub line 1-2, the detector 2 comprising the detection diode D, the smoothing capacitor C1 and the load resistor R, the tuner 3 comprising the inductor L and the capacitor C2, and the first to seventh terminals P1 to P7.

[0062] The first and second terminals P1, P2, and the third and fourth terminals P3, P4 are provided on both ends of the main line 1a-1 of the first directional coupler 1a, and on both ends of the main line 1b-1 of the second directional coupler 1b, respectively. The fifth terminal P5 is provided on one end of the common sub line 1-2 of the first and second directional coupler 1a, 1b, and the terminating resistor Ro is connected thereto. In addition, the sixth terminal P6 is provided on an output end of the detector 2. The seventh terminal P7 is provided between the second directional coupler 1b and the tuner 3, and used in evaluating the characteristic of the first and second directional couplers 1a, 1b.

[0063] The transmission output control system using

the transmission output control device 20 is used in a dual-band type cellular phone terminal capable of responding to the AMPS (800 MHz band) and the PCS (1900 MHz band) with one cellular phone terminal, and its operation is described below with the 800MHz band side as an example.

[0064] The carrier-wave signal generated in an oscillator 5a is converted in the transmission signal of 800 MHz through various processing circuits including an amplifier 6a, and inputted in an high output amplifier 4a. The transmission signal amplified in this high output amplifier 4a is inputted in the antenna multicoupler 7 through the first terminal P1, the directional coupler 1a and the second terminal P2, and transmitted from the antenna ANT after unwanted waves are removed by the antenna multicoupler 7.

[0065] The reception signal received by the antenna ANT is inputted in the reception part Rx after unwanted waves are removed by the antenna multicoupler 7. The instruction information on the transmission output level of the transmission signal is included in the above-described reception signal from a base station.

[0066] A part of the transmission signal from the high output amplifier 4a is branched by the directional coupler 1a, that is, taken out from one end of the common sub line 1-2 and inputted in the detector 2 through the tuner 3.

[0067] In the detector 2, the transmission signal becomes the detection signal through the DC smoothing by the smoothing capacitor C1 and the load resistor R after the transmission signal is rectified by the detection diode D. The detection signal is outputted from the sixth terminal P6 as the TSSI signal corresponding to the transmission output level of the transmission signal to be actually transmitted from the antenna ANT, and inputted in the control circuit 8.

[0068] The control part 9 gives the control signal to indicate the specified transmission output level to the control circuit 8 according to the instruction from the base station not indicated in the figure. Based on the control signal from the control part 9, the control circuit 8 forms the feedback (FB) signal to be effected so that the difference between the actual transmission output level to be recognized by the TSSI signal and the target transmission output level is reduced, and outputted to the control terminal Tc capable of varying the actual transmission output level by the high output amplifier 4a.

[0069] As described above, the transmission output control system comprising a part of the transmission output control device 20 forms a feedback loop in the transmission part Tx, and controls the transmission output level so that the actual transmission output level becomes the target transmission output level given by the control part 9.

[0070] Fig. 6 is a partly exploded perspective view of the transmission output control device of Fig. 5. The transmission output control device 20 is provided with a laminated body 21 in which a plurality of dielectric layers (not indicated in the figure) are laminated.

[0071] The detection diode D and the load resistor R of the detector 2, and the inductor L and the capacitor C2 of the tuner 3 are respectively mounted on an upper surface of the laminated body 21.

[0072] External terminals T1 to T10 are provided from a side surface to a lower surface of the laminated body 21. Out of these external terminals; the external terminals T1, T9, T5, T3, T8, T2, T6 form the first to seventh terminals P1 to P7 (Fig. 5) of the transmission output control device 20 and the external terminals T4, T7, T10 form ground terminals.

[0073] Fig. 7A to Fig. 7H and Fig. 8A to Fig. 8E are a top plan view and a bottom plan view of each dielectric layer to constitute the laminated body of the transmission output control device of Fig. 6. The laminated body 21 is formed, for example, by successively laminating and baking the first to tenth dielectric layers 21a to 21j formed of a low-temperature baked ceramic mainly consisting of barium oxide, aluminum oxide and silica which can be baked at the temperature of 850°C to 1000°C.

[0074] A land La2 to respectively mount the detection diode D of the detector 2, the load resistor R, and the inductor L and the capacitor C2 of the tuner 3 as illustrated in Fig. 5 is formed on an upper surface of the first dielectric layer 21a. A wiring pattern Lp2 and a ground electrode Gp21 are respectively formed on an upper surface of the second dielectric layer 21b.

[0075] In addition, a capacitor electrode Cp2 is formed on an upper surface of the third dielectric layer 21c. Ground electrodes Gp22 to Gp24 are respectively formed on an upper surface of the fourth, seventh and tenth dielectric layers 21 d, 21g, 21j.

[0076] In addition, strip line electrodes ST21 to ST24 are respectively formed on an upper surface of the fifth, sixth, eighth and ninth dielectric layers 21e, 21f, 21 h, 21 i. The external terminals T1 to T10 are formed on a lower surface (denoted as 21ju in Fig. 3H) of the tenth dielectric layer. In addition, a via hole electrode Vh2 is formed in the first to ninth dielectric layers 21a to 21i so as to pierce the respective dielectric layers 21a to 21i.

[0077] The main line 1a-1 of the first directional coupler 1a, and the sub line 1b-1 of the second directional coupler 1b comprise the strip line electrode ST21 and the strip line electrode ST24, respectively.

[0078] The common sub line 1-2 of the first and second directional couplers 1a, 1b comprises the strip line electrodes ST22, ST23.

[0079] Further, the smoothing capacitor C1 of the detector 2 comprises the capacitor electrode Cp2 and the ground electrodes Gp21, Gp22 opposite to each other across the second and third dielectric layers 21b, 21c.

[0080] In addition, the elements to constitute the first and second directional couplers 1a, 1b, the detector 2 and the tuner 3 are connected to each other by the wiring pattern Lp2 and the via hole electrode Vh2 inside the laminated body 21.

[0081] Fig. 9 is a circuit diagram illustrating a modified

example of the output control of Fig. 5. A transmission output control device 20a is different from the transmission output control device 20 of Fig. 5 in that the detector 2 is provided with a thermistor 22 which is a temperature-sensing element to compensate the temperature fluctuation, and an input part bias circuit 23 and an output limiter circuit 24 are provided between the tuner 3 and the detector 2.

[0082] The input part bias circuit 23 comprises resistors R1, R2, and a connection point of one end of the resistor R1 to one end of the resistor R2 is connected to an anode of the diode D of the detector 2, and the other end of the resistor R2 is connected to the ground.

[0083] The output limiter circuit 24 comprises a diode D1 and resistors R3, R4, and the diode D1 is connected between a connection point of one end of the resistor R3 to one end of the resistor R4 and a cathode of the detection diode D of the detector 2 so that the connection point side of one end of the resistor R3 to one end of the resistor R4 forms the cathode.

[0084] The other end of the resistor R3 is connected to the other end of the resistor R1 of the input part bias circuit 23, and also connected to a control terminal PB to apply the bias of the diode D1. In addition, the other end of the resistor R4 is connected to the ground.

[0085] Further, the thermistor 22, the resistors R1, R2 of the input part bias circuit 23, the diode D1 of the output limiter circuit 24, and the resistors R3, R4 are mounted on the upper surface of the laminated body 21. A detection terminal PT to take out the signal from the thermistor 22 and the control terminal PB to control the diode D of the output limiter circuit 23 are provided from the side surface to the lower surface of the laminated body 21 as the external terminals, respectively.

[0086] In the transmission output control device of the second embodiment as described above, two directional couplers ready for the transmission signals of different frequency are formed on different dielectric layers inside the laminated body, and thus, two directional couplers can be arranged through the dielectric layers.

[0087] Thus, sufficient isolation between two directional couplers can be ensured in addition to the effect of the first embodiment. As a result, the transmission output control device with excellent characteristic can be obtained.

[0088] Further, in a modified example of Fig. 9, the temperature characteristic of the detector can be controlled because the detector is provided with the thermistor which is the temperature-sensing element to compensate the temperature fluctuation, and the transmission output can be excellently controlled even when the transmission output control system extensive in the temperature compensation range is constituted.

[0089] The minimum value of the TSSI signal from the transmission output control device to the control circuit is determined by the input part bias circuit, and the maximum value of the TSSI signal from the transmission output control device to the control circuit is determined by the output limiter circuit. Thus, the range of the TSSI signal can be controlled, and as a result, the transmission characteristic of the radio equipment with this transmission output control device mounted thereon can be improved.

[0090] In the above-described first and second embodiments, a transmission output control device provided with the tuner are described, but similar effect can be obtained even in a transmission output control device provided with no tuner.

[0091] Further, the detector of one stage system is described above, but similar effect can be obtained even in an n-times detector of multiple stage system.

[0092] In addition, the modified first and second embodiments provided with the detector having the thermistor, the input part bias part, and the output limiter circuit are described, but similar effect can be obtained even in a case provided with either one or two of them.

[0093] In the transmission output control device of the above-described second embodiment, the dual-band type transmission output control device provided with two directional couplers is described, but similar effect can be obtained for the transmission output control device provided with three or more directional couplers.

[0094] While the invention has been particularly shown and described with reference to preferred embodiments thereof, it will be understood by those skilled in the art that the forgoing and other changes in form and details may be made therein without departing from the spirit of the invention.

Claims

1. A transmission output control device (10; 20) comprising:

   a directional coupler (1; 1a, 1b) to branch a part of a transmission signal amplified by a high output amplifier (4; 4a, 4b); and
   a detector (2) to detect a part of said branched transmission signal;
   wherein said directional coupler (1; 1a, 1b) and said detector (2) are integrated with a laminated body (11; 21) in which a plurality of dielectric layers (11a-11g; 21a-21j)are laminated.

2. The transmission output control device (10; 20) according to Claim 1, wherein:

   said directional coupler (1; 1a, 1b) includes a main line (1-1; 1a-1, 1b-1) and a sub line (1-2);
   said detector (2) includes a detection diode (D), a smoothing capacitor (C1) and a load resistor (R);
   the detection diode (D) and the load resistor (R) of said detector (2) are mounted on said laminated body (11; 21);

the main line (1-1; 1a-1, 1b-1) and the sub line (1-2) of said directional coupler (1; 1a, 1b) comprise strip line electrodes (ST11, ST12) provided inside said laminated body (11; 21); and the smoothing capacitor (C1) of said detector (2) comprises a capacitor electrode (Cp1) and a ground electrode (Gp1, Gp2) provided to be opposed each other via said dielectric layers inside said laminated body (11; 21).

3. The transmission output control device (10; 20) according to Claims 1 or 2, wherein:
a plurality of said directional couplers (1; 1a, 1b) are provided; and the plurality of said directional couplers (1; 1a, 1b) are ready for the transmission signal of different frequencies and disposed on different dielectric layers out of a plurality of said dielectric layers.

4. A radio equipment including the transmission output control device (10, 20) of one of Claims 1 to 3.

FIG. 1

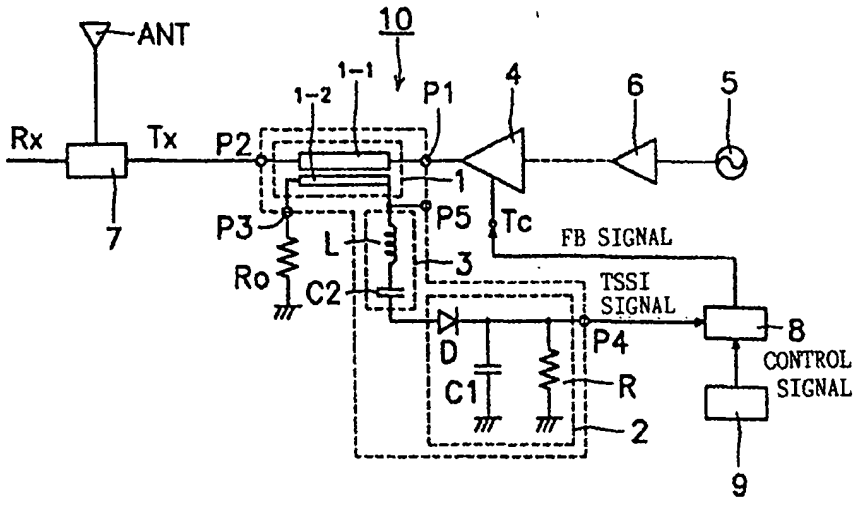

ANT
10
1-1
1-2
P1
4
6
5
Rx
Tx
P2
1
P3
P5
Tc
FB SIGNAL
7
L
3
Ro
C2
TSSI
SIGNAL
8
D
P4
CONTROL
SIGNAL
C1
R
2
9

FIG. 2

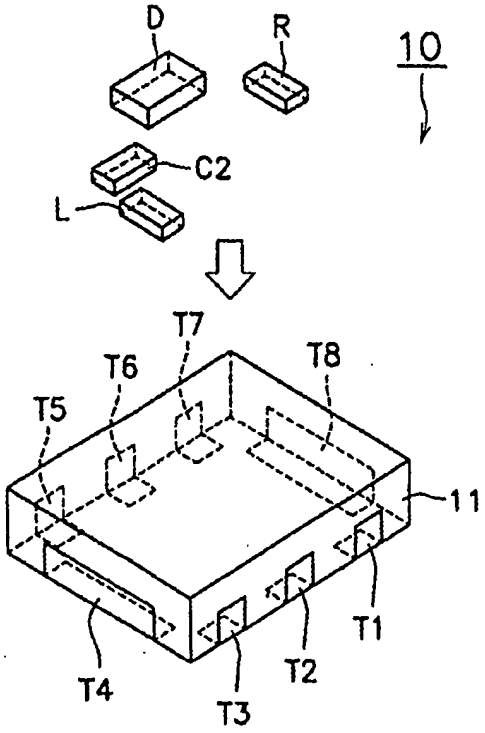

D
R
10
C2
L
T7
T6
T8
T5
11
T1
T4
T2
T3

FIG. 3A

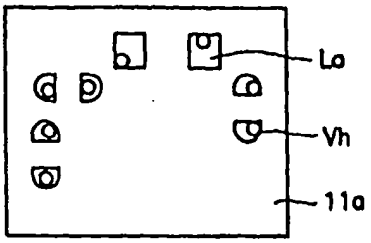


FIG. 3B

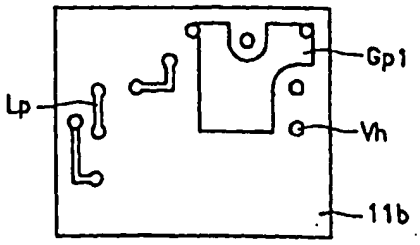


FIG. 3C

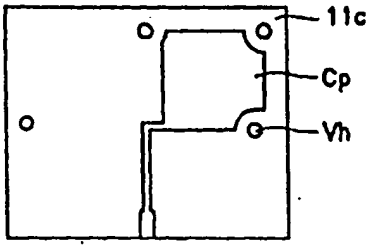


FIG. 3D

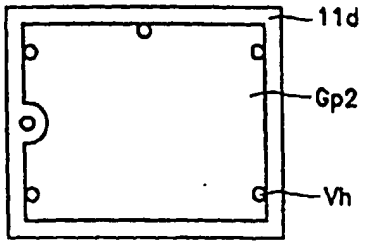


FIG. 3E

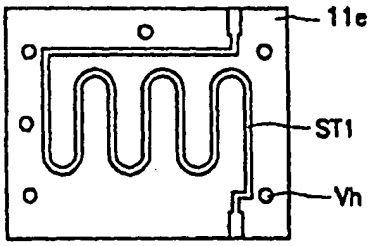


FIG. 3F

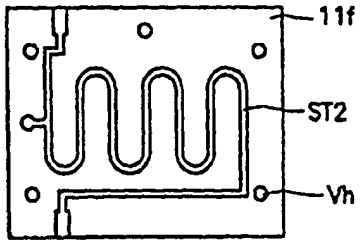


FIG. 3G

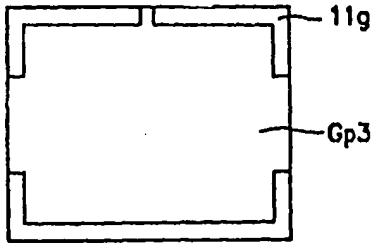


FIG. 3H

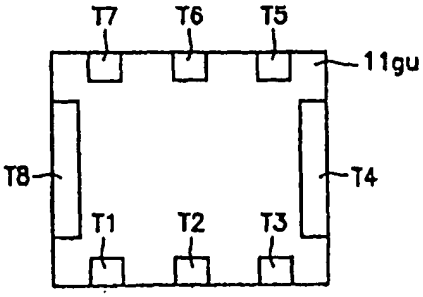


FIG. 4

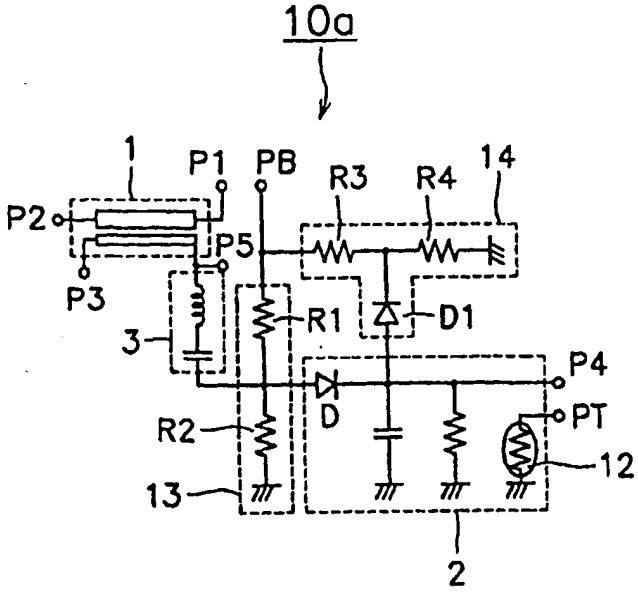

10a
1
P1
PB
R3
R4
14
P2
P5
P3
3
R1
D1
P4
D
PT
R2
12
13
2

FIG. 5

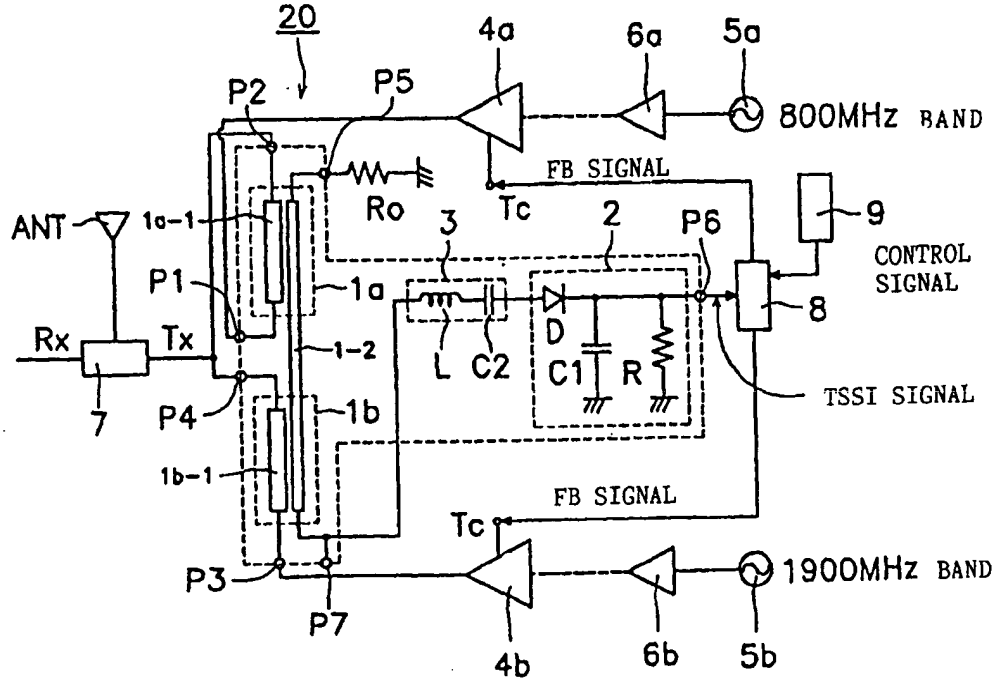

20
4a
6a
5a
P2
P5
800MHz BAND
FB SIGNAL
ANT
1a-1
Ro
3
Tc
2
P6
9
CONTROL SIGNAL
P1
1a
8
Rx
Tx
1-2
L
C2
D
C1
R
TSSI SIGNAL
7
P4
1b
1b-1
FB SIGNAL
Tc
P3
1900MHz BAND
P7
4b
6b
5b

FIG. 6

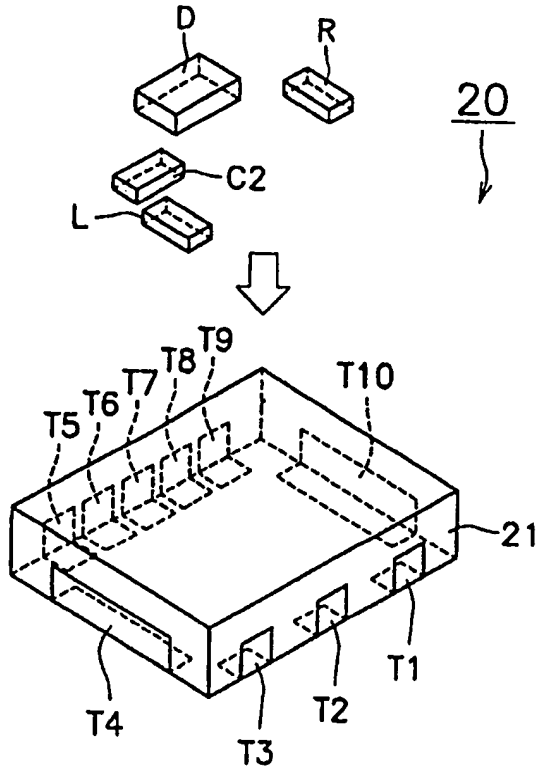


FIG: 7A

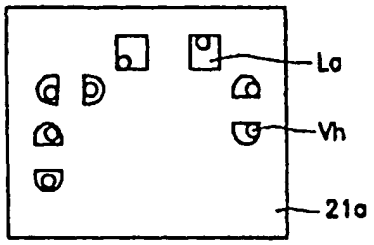


FIG. 7B

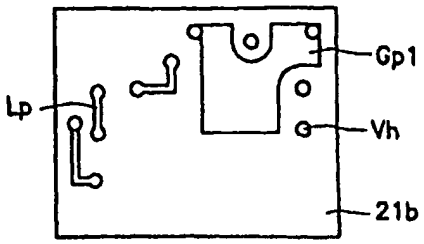


FIG. 7C

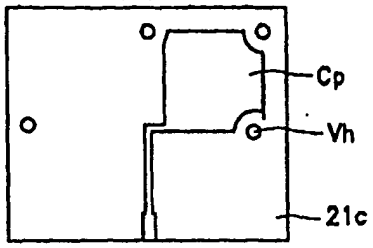


FIG. 7D

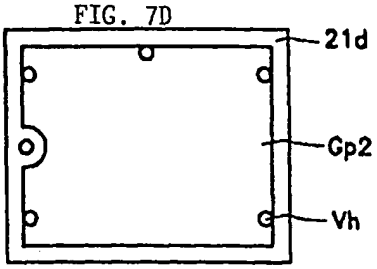


FIG. 7E

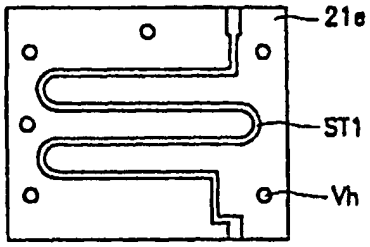


FIG. 7F

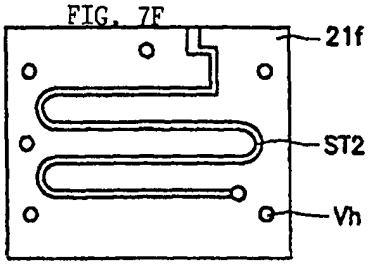


FIG. 8A

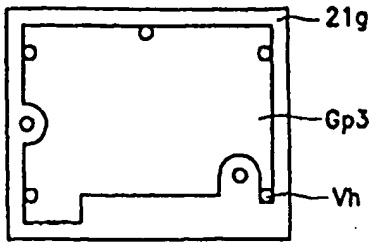


FIG. 8B

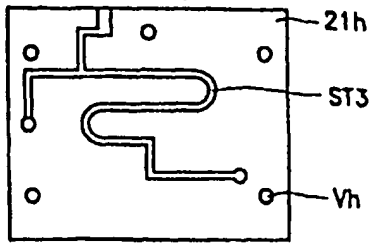


FIG. 8C

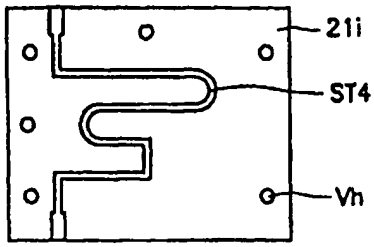


FIG. 8D

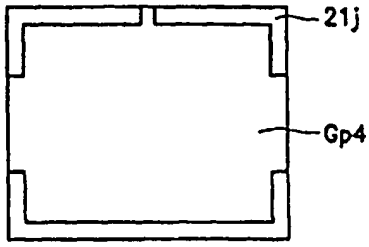


FIG. 8E

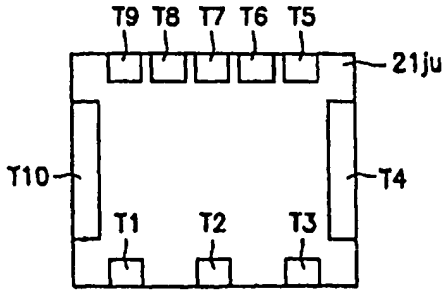


FIG. 9

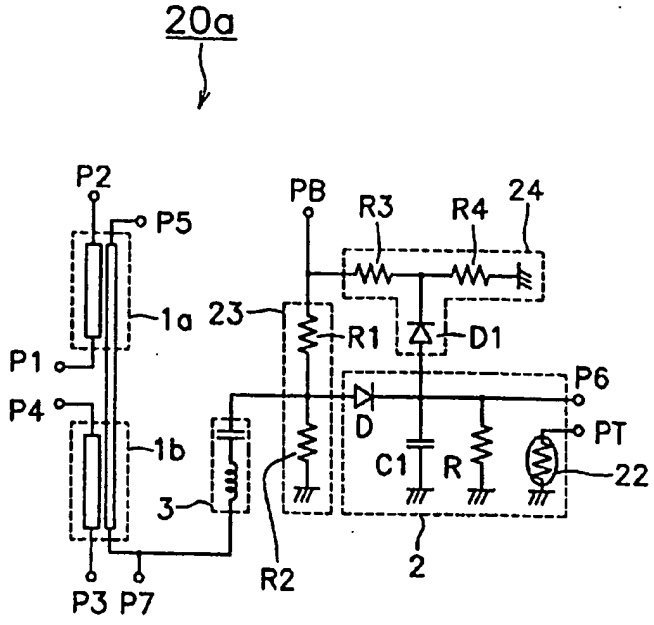

20a
P2
P5
PB
R3
R4
24
1a
23
R1
D1
P1
P6
P4
D
PT
1b
C1
R
22
3
R2
2
P3
P7

FIG. 10

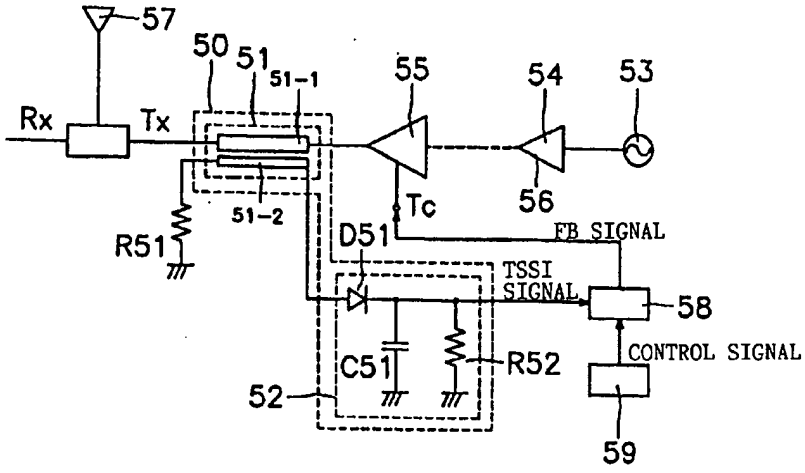
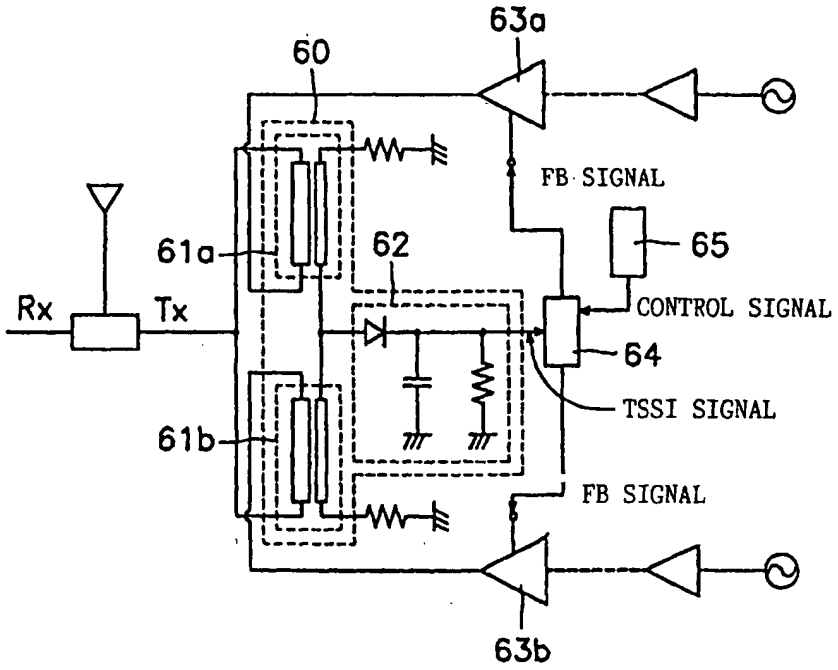

57
50
51
51-1
55
54
53
Rx
Tx
56
Tc
51-2
FB SIGNAL
R51
D51
TSSI
SIGNAL
58
CONTROL SIGNAL
C51
R52
52
59

FIG. 11


63a
60
FB SIGNAL
65
61a
62
Rx
Tx
CONTROL SIGNAL
64
TSSI SIGNAL
61b
FB SIGNAL
63b

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 00 10 5764

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	PATENT ABSTRACTS OF JAPAN vol. 1995, no. 1, 28 February 1995 (1995-02-28) -& JP 06 283908 A (MITSUBISHI ELECTRIC CORP.), 7 October 1994 (1994-10-07) * abstract *	1,4	H01P5/18
A	US 4 476 447 A (LAUCHNER) 9 October 1984 (1984-10-09) * the whole document *	1	
A	EP 0 604 203 A (HARRIS CORPORATION) 29 June 1994 (1994-06-29) * column 3, line 42 - column 4, line 4 * * column 4, line 55 - column 5, line 6; figures 1,5 *	1	
A	PATENT ABSTRACTS OF JAPAN vol. 1995, no. 3, 28 April 1995 (1995-04-28) -& JP 06 334401 A (FUJITSU LTD), 2 December 1994 (1994-12-02) * abstract *	3	

TECHNICAL FIELDS SEARCHED (Int.Cl.7)
G01R
H01P

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	20 July 2000	Den Otter, A

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20-07-2000

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